DNA 3741F-1

DNA MASTER FILE OF GROUND-SHOCK, AIR-BLAST, AND STRUCTURE-RESPONSE DATA

Volume 1: Archive Description and User's Information

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Data Display	Height-of-Burst Tests	DISTANT PLAIN	MINE THROW	PRE-MINE THROW IV
Data Management	Structure Response	FLAT TOP	MINE UNDER	PRAIRIE FLAT
Data Processing	DATA/70S	MIDDLE GUST	MINERAL LODE	SAILOR HAT
Ground Shock	DIAL PACK	MIDDLE NORTH	MINERAL ROCK	SNOWBALL

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A master file of air-blast, ground-shock, and structure-response data was created from selected high-explosive field tests. A brief background of the tests is presented and a comprehensive bibliography is included. The data identification nomenclature, the master file accessing procedures, and the data output formats are all discussed. An example problem is presented.

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SUMMARY

For more than a decade, measured air-blast, ground-motion, and structure-response data have been acquired from a variety of high-explosive field tests. *Volume 1: Archive Description and User's Information* summarizes the activities of the past several years to locate and acquire some of the most important groups of these data, preparatory to general accessing by users.

A brief background of the tests that contributed to the formation of the master file of data is presented, together with an extensive bibliography of relevant published documents. Also discussed are the identification system used in cataloging the data, the documentation procedure describing the master file content, the procedures required to retrieve data from the archive, and the various output formats available to the potential user. The descriptive material is accompanied by various illustrations, and an example case is presented to demonstrate the retrieval, processing, and plotting procedures.

Volume 2: Appendixes presents a summary of the data available at Physics International Company; and a detailed description of the computer software used in forming and maintaining the data archive. The various processing options available to reduce, reformat, and analyze data are included.

PREFACE

The formation of the master file of high-explosive data described in this report and the use of the data management and data processing software to retrieve, process, and display the data were authorized and supported by the Defense Nuclear Agency. Major R. Waters was the Contracting Officer's Representative (COR) during the early part of the program. Lt Col. D. Burgess was the COR for the remainder of the work. The initial effort was performed under Contract No. DNA001-73-C-0058, NWE T Subtask Code L17DAXSX318, Work Unit Code 01 and NWE D Subtask Code Y99QAXSD164, Work Unit Code 01. The work was completed under Contract No. DNA001-75-C-0154, NWE D Subtask Code Y99QAXSD164, Work Unit Code 07.

A project of this type requires the support and patience of many individuals in various organizations. It is not possible to acknowledge the many participants who contributed to the ultimate success of the project. Nevertheless, special thanks must go to Messrs. L. Ingram and J. Brogan of the Waterways Experiment Station; Messrs. J. Gordon and H. Jenkins of the Air Force Weapons Laboratory; Mr. J. Keefer of the Ballistics Research Laboratories; Mr. E. Martin and Dr. L. Kennedy of GE TEMPO; Dr. T. Stubbs of Physics International Company; and Mr. J. Carpenter of R & D Associates.

Agbabian Associates personnel who contributed extensively to the project were J. Malthan, Project Manager; E. Raney, Project Engineer; and R. H. Brandt, Staff Engineer. Technical editing of the final report was performed by J. Radler.

CONTENTS

Volume I

		Page
Summary		1
Preface		2
Section		
1	Introduction	5
	1.1 Background	5
	1.2 Project Objectives	9
	1.3 Project Scope	9
	1.4 Report Organization	11
2	Data Archive Description	12
	2.1 Master File Summary	13
	2.2 Data Directories	17
	2.3 Data Identification System	20
3	Data Management System	24
	3.1 Access to the System	26
4	Data Processing	29
	4.1 Processing Requests	31
	4.2 Illustrative Example	36
5	Data Display	42
6	Selected Bibliography	45
6A	Bibliography Addendum	67

Volume 2

Summary		i
Preface		ii
Appendix		
A	Measured Data at Physics International Company	A-1
B	DATA/70S Program Description	B-1
C	DATA/70S Processing Options	C-1

ILLUSTRATIONS

Figure		Page
1	Typical Page of Directory Printout	17
2	Typical Page of Sorted-Directory Printout	19
3	Cross-Index of Original Measurement Numbers and the Identification Indicator	20
4	The DATA/70S System	25
5	Original and Modified Identification Indicator	31
6	Composition of Processing Requests	37
7	An Example of a Processing Request Job Run	38
8	Example of Plotted Output	43

TABLES

Table		
1	Summary of Free-Field Data in Master File	14
2	Summary of Structures Data in Master File	16
3	Identification Indicator Code	22
4	Basic MAC/RAN Operations	30
5	Process Control Card Options	32
6	Management Control Card Functions	34
7	Postprocessing Disposition Functions	35

SECTION 1

INTRODUCTION

As a result of the voluntary nuclear test moratorium in late 1958 and the official Test Ban Treaty in mid-1963, alternatives to atmospheric nuclear testing were required to continue the experimental study of nuclear weapons effects (NWE). Although shock tubes and various blast-load generators were developed that could simulate nuclear air blast, only large-scale field tests could provide experimental cratering information, air-blast-induced and direct-induced ground shock, structural and equipment response data, biomedical information, and other phenomena associated with the mechanical aspects of explosions. These phenomena were investigated in field tests in which high-yield chemical explosives (HE) were used in lieu of nuclear energy devices.

1.1 BACKGROUND

The first of the postmoratorium HE shots, conducted in 1959 at the Defence Research Establishment in Suffield, Canada, consisted of 5-ton, 20-ton, and 100-ton hemispherical TNT charges. These were followed by other HE shots at the Nevada Test Site (NTS) and elsewhere, both prior to and following the resumption of atmospheric nuclear testing in 1961. However, the Test Ban treaty made it clear that the HE technique was to become a permanent part of the NWE program. Subsequent paragraphs describe some of the more familiar tests.

The first posttreaty test was a series of HE experiments called FLAT TOP, which was conducted at NTS. Events II and III were 20-ton, half-buried shots in alluvium; Event I was an identical shot in limestone. The primary purpose of this series was to obtain information on cratering and air blast to provide for a rational transition from the nuclear experiments that had been planned prior to the treaty.

In mid-1964, the 500-ton hemispherical shot SNOWBALL was conducted in Canada. It was made up of a comprehensive group of projects, notably blast studies, ground-motion measurements, and structure-response experiments.

In 1965, the SAILOR HAT series of three 500-ton hemispherical shots was conducted on Kahoolawe, Hawaii. The primary purpose of this test was to study the response of ships to air blast.

A lengthy series of DISTANT PLAIN shots was begun in mid-1966 at the Canadian test site. Events I and I-A were 20-ton tower shots to investigate air-blast and air-blast-induced ground shock. Events II and II-A were 20-ton-equivalent, hemispherical gas-balloon experiments to determine the feasibility of using gaseous-mixture energy in lieu of chemical explosives. Event III was a 20-ton half-buried shot to investigate close-in ground shock to be correlated to FLAT TOP I, II, and III. Event V was a shot identical to Event III except that it was conducted over frozen ground. Event VI-A, also a 20-ton surface shot to study air blast and cratering, was a preliminary shot to Event VI, which was a 100-ton surface detonation. Event IV was a 50-ton hemispherical shot conducted in a forest to determine air-blast, cratering, and ground-shock effects in a blowdown condition. The DISTANT PLAIN series was completed in the fall of 1967.

The Canadian series of tests continued with the 500-ton PRAIRIE FLAT surface shot conducted in August 1968. PRAIRIE FLAT also encompassed a number of projects that included the usual air blast, air-blast-induced and direct-induced ground shock, cratering, structure and equipment responses, and biomedical experiments.

Also in 1968 the MINE SHAFT series was conducted in granite near Cedar City, Utah. The series consisted of the MINE UNDER 100-ton tower shot and the MINE ORE 100-ton partially buried shot. MINERAL LODE was a 15-ton fully buried shot, whereas MINERAL ROCK was a 100-ton partially buried shot. This series of tests was completed by late 1969.

The last large-scale Canadian event conducted to date (1975) was the 500-ton DIAL PACK surface shot detonated in mid-1970. It continued the study of air-blast, ground motion, and structure response in soils, and it was also to be correlated to DISTANT PLAIN Events VI and VI-A and to Event PRAIRIE FLAT.

MINE THROW I at NTS was a 120-ton ammonium nitrate/fuel oil (ANFO) shot, buried in alluvium, that was designed to be correlated to the JOHNIE BOY nuclear shot. This test was conducted in December of 1971.

The most recent large-scale HE field-test series was MIDDLE NORTH, conducted in 1971 and 1972. It was comprised of the MIXED COMPANY and MIDDLE GUST events to investigate cratering at soil-over-rock sites by simulating 1-kT nuclear devices. MIXED COMPANY I was a 20-ton half-buried charge that was also a calibration shot for MIXED COMPANY II, which was a 20-ton surface detonation. MIXED COMPANY III was a 500-ton surface shot to be used for correlating measurements to cratering, ground-shock, and structure-response predictions. All MIXED COMPANY events were conducted near Grand Junction, Colorado, at a sand-over-limestone location.

The MIDDLE GUST events were conducted near Pueblo, Colorado, to investigate ground response in clay-over-shale geologies. Event I was a 20-ton half-buried shot to be correlated to FLAT TOP and DISTANT PLAIN Events III and V. Event II was a 100-ton tower shot to study air blast, and to be correlated to DISTANT PLAIN I and to MINE UNDER. Event III was a 100-ton surface test designed to be correlated to DISTANT PLAIN VI, PRAIRIE FLAT, and DIAL PACK. Events IV and V were 100-ton surface and 20-ton half-buried shots, respectively.

In 1973, the PRE-MINE THROW IV series of nine events was executed at NTS. The charges varied from 256 pounds to 100 tons of nitromethane and TNT. The primary objective of these tests was to obtain ground-motion and crater-volume data.

The preceding tests are the best-known HE events conducted since 1959, and all consist of the point-source test configuration. Omitted are many other, lesser-known point-source HE events, nuclear tests, and the High Explosive Simulation Technique (HEST) tests and the ROCKTEST series.

Most of these data probably could be acquired, if desired. Some may be difficult or impossible to find. In a recent survey, Physics International Company (PI) tabulated the data available at its organization.* The tabulations refer to ground-motion data resident on analog and digital magnetic tapes and, for the nuclear tests, on analog strip charts. These tabulations are summarized in Volume 2, Appendix A, of this report.

**Feasibility of Archiving, at Agbabian Associates, the Ground Motion Data Residing at Physics International Company.*

1.2 PROJECT OBJECTIVES

The various tests described above produced a large volume of air-blast, ground-motion, and structure-response measurements. Although most of these data are available in hard copy (i.e., in various reports), this form is not very satisfactory for detailed data analysis. More significantly, most published data have been manipulated to remove noise, trends, and other signal errors. Rarely are the correction methods defined in the published reports. Accordingly, the need to develop a central file of raw data that could be readily accessed by the technical community was identified by DNA as a high-priority task.

In October 1972 a project was begun at Agbabian Associates to ferret out the most readily obtainable data and to develop and maintain a DNA data archive. The archive was to consist of a master file of data and a directory describing its contents, all to be permanently stored on digital magnetic tapes.

The project tasks were to (1) locate useful data, (2) coordinate its transfer from the source agencies to the offices of Agbabian Associates, (3) add the data to the Master File, (4) prepare a data directory, (5) maintain the Master File and the Directory, and (6) prepare the present document to be used as a vehicle for describing the Data Archive, the data-base management system and processors, and the basic procedures for accessing the data. Agbabian Associates was also to provide a technical service for DNA and its contractors or other designated agencies, to retrieve data from the Master File, to process data, and to perform various comparative and statistical analyses.

1.3 PROJECT SCOPE

The project was guided by certain basic constraints: (1) generally, only free-field air-blast and ground-shock data would be archived for the events described in Section 1.1, excluding SAILOR HAT; (2) structure-response measurements would usually be excluded; and (3) all nuclear-response measurements would be avoided. These guidelines effectively provided for a master file that would be unencumbered by national security restrictions. It also precluded the acquisition of very important but highly specialized test events such as HEST and ROCKTEST.

Actually, these guidelines were relaxed when it was appropriate or convenient to do so. Thus, when it was possible to acquire structure-response data with very little additional effort, and if such data had no national security implications, it was acquired and added to the Master File. Such circumstances occurred for certain MIDDLE GUST and MIXED COMPANY events.

On the other hand, air-blast measurements for some events not discussed in Section 1.1 have been added to the Master File. These include small-scale height-of-burst (HOB)* tests conducted by the TRW Systems Group (TRW) and large-scale HOB+ tests conducted by the Ballistics Research Laboratories (BRL).

Moreover, Agbabian Associates acts as an informal custodian for data that conform to the spirit of the project, even if such data cannot be formally archived within the current budget. An example is the HOB data for the DIPOLE WEST Project‡, which were acquired from GE TEMPO.

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*H.J. Carpenter, *Height-of-Burst Blast Effects at High Overpressure.*

+J. Keefer and R. Reisler, *Height-of-Burst Parameters for 1000-pound TNT Charges* (forthcoming).

‡J. Keefer and R. Reisler, *Multiburst Environment -- Simultaneous Detonations, Project DIPOLE WEST.*

1.4 REPORT ORGANIZATION

The report is presented in two volumes. Section 2 of this volume presents a description of the DNA Data Archive, including a summary of the free-field air-blast and ground-motion data and the structure-blast and response measurements, all tabulated by event, parameter, and orientation. Each file of data in the Master File is accompanied by an entry in a data directory that functions as an index of the data. A master identification indicator is assigned to each entry in the Master File and the Directory so that specific data channels may be easily accessed.

Section 3 presents a brief description of the operation of the DATA/70S Data Base Management and Processing System with which the data are archived, retrieved, processed, and displayed.

An overview of the manner in which the data are accessed and processed is discussed in Section 4. This section is directed primarily toward the engineer/analyst whose interest lies in system use rather than system design.

Section 5 describes the output of DATA/70S, especially the plotting formats that are of special interest to the data analyst.

Section 6 presents a bibliography of the references included in the text and documents related to the data contained in the Master File.

Volume 2 presents a summary of the data available at the Physics International Company, most of which have not been entered into the Master File; a detailed description of the DATA/70S System; and the options available in DATA/70S for processing data.

SECTION 2

DATA ARCHIVE DESCRIPTION

An extensive search was made to locate and acquire the relevant data for all test events identified in Section 1.1 except SAILOR HAT. The only event for which no data could be found on digital magnetic tape was SNOWBALL. Other data, identified in Section 1.3, were also acquired and added to the Master File, even though they were not part of the various series described in Section 1.1.

The principal sources of original data were the Army Engineer Waterways Experiment Station (WES), the Air Force Weapons Laboratory (AFWL), the Army Ballistic Research Laboratories (BRL), and the Physics International Company (PI). At all agencies other than BRL, the data were available in a digital format, although extensive reformatting was sometimes necessary in order to achieve compatibility with the central processor in Los Angeles. The BRL data required digitizing, which was performed at Sandia Laboratories under the direction of GE TEMPO.

Digital magnetic tape for the FLAT TOP series of tests was found at DASIAC. However, difficulties were encountered in reading these tapes, and the effort was deferred in favor of addressing more easily accessed data. One such activity was the accession and processing of Eight-Pound Charge Height-of-Burst air-blast data from a recent test series conducted in California by TRW. Another large block of 1000-Pound Charge Height-of-Burst air-blast data was obtained from BRL for a Canadian test series conducted in 1969.

2.1 MASTER FILE SUMMARY

A summary of the free-field air-blast and ground-motion data currently resident in the DNA Master File is presented in Table 1. A much more modest quantity of structure blast-loading and response data is presented in Table 2. The free-field and structures data occupy 4551 and 278 files, respectively.

The DNA Master File containing parameter-time histories for the data presented in Tables 1 and 2 is retained on 42 reels of digital magnetic tape. Each channel of data is identified by a nomenclature system described in Section 2.3. A permanent list of the data in the Master File is maintained on the Data Directories described in Section 2.2.

The data were obtained from the originating agencies in the "raw" form, even when "corrected" data were available. *Raw data* is here construed to mean the output obtained directly from the digitizers, in which antialiasing filtering and sometimes offset corrections are the only external processing applied to the data. *Corrected data* would indicate data that have been additionally processed to remove noise, drift, and other aberrations. Of necessity, the additional processing requires a subjective selection of the corrective methods for purging the data of undesirable characteristics. From an archiving point of view, previously processed data are less valuable than the raw data, for two reasons. First, the application of various data processes always carries with it the danger of distorting the true signal. Second, because data processing techniques change from time to time as new technologies are developed, no single procedure can be considered absolutely correct. Accordingly, data in the raw form were selected for permanent retention. The reader is

TABLE 1. SUMMARY OF FREE-FIELD DATA IN MASTER FILE
Numbers Indicate Total Channels of Data

EVENT		PARAMETER																												
		AIR BLAST							ACCELERATION					VELOCITY				STRESS					STRAIN							
		VERTICAL	SIDE ON	TOTAL	X-AXIS	Y-AXIS	OMNIDIRECTION	MISCELLANEOUS	VERTICAL	RADIAL	TRANSVERSE	HORIZONTAL	MISCELLANEOUS	VERTICAL	RADIAL	TRANSVERSE	HORIZONTAL	VERTICAL	RADIAL	TRANSVERSE	HORIZONTAL	OBLIQUE	VERTICAL	TRANSVERSE	HORIZONTAL	OBLIQUE	PORE PRESSURE	TIME OF ARRIVAL	CABLE NOISE	MISCELLANEOUS
DISTANT PLAIN	I		18	12	14	7																								
	IA		23	4																										
	IIA		9	6	6	2																								
	III		12	3	3																									
	IV		23	13	14																									
	V		11	4																										
	VI		19	5	4																									
PRAIRIE FLAT		12	31	10														12		2	12	9								
MINE UNDER			31	4					20	13		5		6	6								6	6	6	6				
MINE ORE			29	4					53			42		12			11						15	14	9	14				
MINERAL LODE									14	13	11			6	11			9*	9*	9*	9*	9*						7		1
MINERAL ROCK			38	4					40	41			2	40	41													2		
1000 POUND CHARGE HOB	1		28	15																										
	2		29	16																										
	3		30	16																										
	4		29	16																										
	5		31	17																										
	6		30	16																										
	7		30	15																										
	8		33	16																										
	9		33	16																										
	10		33	16																										
	11		31	16																										
	12		31	16																										

* Measurement orientation unverified

TABLE 1. (CONTINUED)
Numbers Indicate Total Channels of Data

EVENT		PARAMETER																												
		AIR BLAST							ACCELERATION					VELOCITY				STRESS					STRAIN							
		VERTICAL	SIDE ON	TOTAL	X-AXIS	Y-AXIS	OMNIDIRECTION	MISCELLANEOUS	VERTICAL	RADIAL	TRANSVERSE	HORIZONTAL	MISCELLANEOUS	VERTICAL	RADIAL	TRANSVERSE	HORIZONTAL	VERTICAL	RADIAL	TRANSVERSE	HORIZONTAL	OBLIQUE	VERTICAL	TRANSVERSE	HORIZONTAL	OBLIQUE	PORE PRESSURE	TIME OF ARRIVAL	CABLE NOISE	MISCELLANEOUS
DIAL PACK			34	13					32			11		26			22	16			5	2								1
MINE THROW I									20			20		20			20													
MIXED COMPANY III		13							61		2	62		83			81	20			20									
MIDDLE GUST	I	4					6	5	15	11	5			27	23	1														
	II	44					11		56	51	11			120	122	19		19	9			6							2	
	III	7							58	58	3			43	52	10		3			2	1					1			
	IV	31							66	64				100	99	17		12	12			4								
	V	13							44	40				36	34			6	6			2								
EIGHT POUND CHARGE HOB	1		39																											
	2		39																											
	3		39																											
	4		39																											
	5		39																											
	6		39																											
	7		39																											
	8		39																											
	9		39																											
	10		39																											
	11		39																											
	12		47																											
	13		49																											
	14		47																											
	15		39																											
	16		39																											
	17		39																											

TABLE 1. (CONCLUDED)
Numbers Indicate Total Channels of Data

EVENT		PARAMETER																												
		AIR BLAST							ACCELERATION					VELOCITY				STRESS					STRAIN				PORE PRESSURE	TIME OF ARRIVAL	CABLE NOISE	MISCELLANEOUS
		VERTICAL	SIDE ON	TOTAL	X-AXIS	Y-AXIS	OMNIDIRECTION	MISCELLANEOUS	VERTICAL	RADIAL	TRANSVERSE	HORIZONTAL	MISCELLANEOUS	VERTICAL	RADIAL	TRANSVERSE	HORIZONTAL	VERTICAL	RADIAL	TRANSVERSE	HORIZONTAL	OBLIQUE	VERTICAL	TRANSVERSE	HORIZONTAL	OBLIQUE				
	18		39																											
	19		39																											
	20		39																											
EIGHT	21		39																											
POUND	22		39																											
CHARGE	23		39																											
HOB	24		39																											
	25		39																											
	26		39																											
	27		39																											
	28		46																											

TABLE 2. SUMMARY OF STRUCTURES DATA IN MASTER FILE
Numbers Indicate Total Channels of Data

EVENT		PARAMETER			
		AIR-BLAST LOAD	STRUCTURE RESPONSE		
			ACCELER-ATION	VELOCITY	STRESS
MIDDLE	II	13	1		
GUST	IV	1			
MIXED COMPANY	III	123		118	22

invited to study Section 3, however, which describes the method for retaining processed data in the Master File for reference purposes.

2.2 DATA DIRECTORIES

Data entered into the Master File are sequentially recorded onto magnetic digital tapes. As each file is added to the Master File, an entry is also made on a directory tape. This entry consists of (among other things) an identifier and the file and reel number address where each channel of data can be located. Hence, the Master File and the Directory have a relationship similar to the books and the card catalog in a library.

An example of directory printout is shown in Figure 1. The 20-character codes under the Identification column are channel identifiers known as Identification Indicators, which are described in Section 2.3. The Master File begins with Absolute File Number 1 on Tape Number 1, which will require a certain footage on the reel. For each new data channel added to the Master File, the Absolute File indexes by one until the Footage indicates

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DATA MANAGEMENT AND PROCESSING SYSTEM

UNCLASSIFIED DIRECTORY TAPE NUMBER 89 PAGE 1

IDENTIFICATION	ABS. FILE	REF. FILE	TAPE NO.	FILE NO.	FOOT-AGE	FACTORS CLASS.	FACTORS UNCLASS.	DELTA X	FLAGS DEL UPDT
03FEAN040A150R020 A	1	1	1	1	35.6	.10000+01	.10000+01	.20000-04	
03FEAN008A150R080 A	2	2	1	2	71.3	.10000+01	.10000+01	.20000-04	
03FEAV1.5A150R110 A	3	3	1	3	106.9	.10000+01	.10000+01	.20000-04	
03FEAV008A150R110 A	4	4	1	4	142.5	.10000+01	.10000+01	.20000-04	
03FEAN1.5A150R110 A	5	5	1	5	178.1	.10000+01	.10000+01	.20000-04	
03FEAN008A150R110 A	6	6	1	6	213.8	.10000+01	.10000+01	.20000-04	
03FEAV017A150R110 A	7	7	1	7	249.4	.10000+01	.10000+01	.20000-04	
03FEAV012A150R110 A	8	8	1	8	285.0	.10000+01			
03FEAN017A150R110 A	9	9	1	9					
03FEAN012A150R110 A									

FIGURE 1. TYPICAL PAGE OF DIRECTORY PRINTOUT

that the first reel is nearly full. At that point, Tape Number 2 is begun, the Absolute File number continues to sequence, and the process continues until all available data are entered into the Master File. There is no practical limit to the amount of data entered into the Master File, i.e., to the number of reels of tape comprising the Master File. As long as the data are not processed, (that is, are virgin data when added to the Master File), the Absolute and Reference File numbers are the same.

In the processing mode of system operation, as described in Section 4, data that are processed and returned to the Master File for storage are assigned the next available Absolute File number. In this case, the Reference File number refers to the Absolute File number of the preprocessed data. This is demonstrated in Figure 2. It should be noted that the storage of processed data does not replace the original data.

The Classified and Unclassified Factors are provided as a means of managing or processing data whose national-security classification requires special handling. When this mode of operation is required, the data on the Master File are normalized, and the normalization factor is entered as a Classified Factor on a separate directory tape called the Classified Directory. By so doing, the Master File usually can be treated as unclassified data. The declassified Master File can be accessed or processed with the Unclassified Directory, in which case normalized data will be output, and no special handling is required.

When classified data must be obtained, the Classified Directory must be used and the computer processing must be conducted in a restricted mode appropriate to the national-security requirements of the original data. Obviously, there is a great deal of merit attached to declassified operation whenever possible. No classified data are resident on the Master File at the writing of this report.

The column entitled "Delta X" in Figure 1 refers to the digitizing time interval for each file. The Flags column is an entry reserved for file maintenance activities.

For convenience, the directories can be printed in either a sorted or unsorted mode. The unsorted directory printout, classified or unclassified, is simply a listing of the data in the Master File in sequential order, that is, in the order in which the Master File was created. The sorted directory, on the other hand, is a listing of the data in an alphanumeric sorting of the Identification Indicators. This enables the user to quickly find the existence and location of specific data channels in the Master File. It also provides a means to determine what processing was applied to data that were subsequently stored. An example of the sorted directory is shown in Figure 2. The format of the Identification Indicator for processed data is described in Section 4.

AGBABIAN ASSOCIATES
DATA MANAGEMENT AND PROCESSING SYSTEM

UNCLASSIFIED DIRECTORY TAPE NUMBER 89 PAGE 8

IDENTIFICATION		ABS. FILE	REF. FILE	TAPE NO.	FILE NO.	FOOT-AGE	FACTORS CLASS.	FACTORS UNCLASS.	DELTA X	FLAGS DEL UPDT
12BEPS0005933R054	ILI	2172	2171	20	99	823.6	.10000+01	.10000+01	.10000-05	
12BEPS0005933R054	P	1624	1624	16	70	677.5	.10000+01	.10000+01	.10000-05	
12BEPS0005933R054	PL	2171	1624	20	98	813.9	.10000+01	.10000+01	.10000-05	
12BEPS0005933R060	ILI	2174	2173	20	101	843.0	.10000+01	.10000+01	.10000-05	
12BEPS0005933R060	P	1625	1625	16	71	887.2	.10000+01	.10000+01	.10000-05	
12BEPS0005933R060	PL	2173	1625	20	100	833.3	.10000+01	.10000+01	.10000-05	
12BEPS0005933R063	ILI	2176	2175	20	103	862.3	.10000+01	.10000+01	.10000-05	
12BEPS0005933R063	P	1626	1626	16	72	696.9	.10000+01			
12BEPS0005933R063	PL	2175	1626	20						
12BEPS0005933R066	ILI									

FIGURE 2. TYPICAL PAGE OF SORTED-DIRECTORY PRINTOUT

The complete sorted and unsorted directories for the current data resident in the DNA Master File are necessary documents for those who intend to access, process, or display the data. These documents are published as separate volumes.*

2.3 DATA IDENTIFICATION SYSTEM

The Identification Indicators exemplified in Figures 1 and 2 are a part of a unified system specifically designed for free-field and structure-response measurements. This identification system invariably will be different from the measurement numbers originally assigned to the data, which vary from test to test. However, since many investigators will be accustomed to using the original number rather than the new Identification Indicator, the directories will contain a cross-indexing system for ready reference. A typical example of the cross-index is shown in Figure 3. The meaning of the original measurement number for a particular test is described in the appropriate document from the bibliography presented in Section 6.

ORIGINAL MEASUREMENT NUMBER		IDENTIFICATION INDICATOR	
MG2-F-E-L26B-020-240-040-V-V	GAGE LOCATED 4 FT CW	02FEVV 20A240R040	V
MG2-F-E-L26B-008-240-040-V-V	GAGE LOCATED 4 FT CW	02FEVV 08A240R040	V
MG2-F-E-L26C-1.5-240-040-V-V	GAGE LOCATED 8 FT CCW	02FEVV1.5A240R 40	V
MG2-F-E-L21B-012-150-040-V-V	GAGE LOCATED 4 FT CW	02FEVV 12A150R040	V
MG2-F-E-L218-008-150-040-V-V	GAGE LOCATED 4 FT CW	02FEVV 08A150R040	V
MG2-F-E-L26B-020-240-040-V-H	GAGE LOCATED 4 FT CW	02FEVN 20A240R040	V
MG2-F-E-L268-008-240-040-V-H	GAuE LOCATED 4 FT CW	02FEVN 08A240R040	V
MG2-F-E-L26C-1.5-240-040-V-H	GAGE LOCATED 8 FT CCW	02FEVN1.5A240R 40	V
MG2-F-E-L218-012-150-040-V-H	GAGE LOCATED 4 FT CW	02FEVN	
MG2-F-E-L21B-008-150-040-V-H	GAGE		
MG2-F-E-			

FIGURE 3. CROSS-INDEX OF ORIGINAL MEASUREMENT NUMBERS AND THE IDENTIFICATION INDICATOR

*Agbabian Associates, *Data Directory: DNA Data Archive*.

The Identification Indicator conforms to the format presented in Table 3. It consists of fields, or reserved spaces, that correspond to the test event, the general location of the measurement device (e.g., free field), the sensor type, its orientation, and its physical placement. Thus, the particular measurement illustrated in Table 3, 42FEVV100A180R085 V, refers to a free-field vertical velocity measurement obtained from event MINERAL LODE in which the gage was buried at a depth of 100 ft and at an azimuth of 180 deg from true North and at a range of 85 ft from ground zero, which was the reference point.

Most of the data in the Master File will adapt to the format in Table 3. When that is not possible, as for example with specialized structure-response measurements, the Special Code in Table 3 is activated. A detailed explanation of this use of the Special Code is presented in the Directory.

When the data in the Master File are processed and returned for retention, the 20-character Identification Indicator is expanded to a 30-character format to provide a historical record of the type of processing applied to the data. The format of the updated identification scheme is described in Section 4.

TABLE 3. IDENTIFICATION INDICATOR CODE

IDENTIFICATION CODES	TEST		LOCATION	ACQUISITION	PARAMETER	ORIENTATION	DEPTH			COORDINATE 1	DISTANCE			COORDINATE 2	DISTANCE			SPECIAL	BLANK	PARAMETER
TYPICAL IDENTIFICATION INDICATOR	4	2	F	E	V	V	1	0	0	A	1	8	0	R	0	8	5			V
COLUMN NUMBERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

TEST CODE (COLUMNS 1 AND 2)

01-05	MIDDLE GUST EVENTS I THROUGH V
06	MIXED COMPANY III
07	MINE THROW I
08-10	RESERVED FOR FLAT TOP EVENTS I THROUGH III
11-38	TRW EIGHT-POUND CHARGE, HOB SERIES, SHOTS 1 THROUGH 28
39	PRAIRIE FLAT
40	MINE UNDER
41	MINE ORE
42	MINERAL LODE
43	MINERAL ROCK
44	DIAL PACK
46-57	BRL 1000-POUND CHARGE, HOB SERIES, EVENTS 1 THROUGH 12
58-64	DISTANT PLAIN EVENTS I, IA, IIA, III, IV, V, AND VI

LOCATION CODE (COLUMN 3)

F	FREE FIELD
S	STRUCTURE
H	SHELTER
M	MISCELLANEOUS

ACQUISITION CODE (COLUMN 4)

E	ELECTRONIC
M	MECHANICAL
O	OTHERS

PARAMETER CODE (COLUMN 5)

A	ACCELERATION
V	VELOCITY
D	DISPLACEMENT
F	STRESS
S	STRAIN
P	PRESSURE
T	TEMPERATURE
O	TIME OF ARRIVAL
R	RELATIVE DISPLACEMENT
K	SHOCK SPECTRA
C	CABLE NOISE
E	ELECTRICAL
B	PORE PRESSURE
M	OTHER

ORIENTATION CODE (COLUMN 6)

V	VERTICAL
L	LONGITUDINAL
H	HORIZONTAL
T	TRANSVERSE
A	ELEVATION ANGLE
N	RADIAL OR NORMAL
C	CIRCUMFERENTIAL OR TANGENTIAL
X	X AXIS
Y	Y AXIS
S	SIDE ON
F	HEAD ON
U	TOTAL
R	REFLECTED
O	OMNIDIRECTIONAL
M	MISCELLANEOUS

TABLE 3. (CONCLUDED)

IDENTIFICATION CODES	TEST	LOCATION	ACQUISITION	PARAMETER	ORIENTATION	DEPTH	COORDINATE 1	DISTANCE	COORDINATE 2	DISTANCE	SPECIAL	BLANK	PARAMETER
TYPICAL IDENTIFICATION INDICATOR	4 2	F	E	V	V	1 0 0	A	1 8 0	R	0 8 5			V
COLUMN NUMBERS	1 2	3	4	5	6	7 8 9	10	11 12 13	14	15 16 17	18	19	20

DEPTH CODE (COLUMNS 7, 8, AND 9)

ROUNDED TO NEAREST FOOT UNLESS DECIMAL APPEARS.
(NOTE: Elevations above grade are indicated by a negative sign, e.g., -15.)

* COORDINATE 1 CODE (COLUMN 10)

N REFERENCE NORTH
S REFERENCE SOUTH
A AZIMUTH

DISTANCE CODE (COLUMNS 11, 12, AND 13)

* ROUNDED TO NEAREST FOOT UNLESS DECIMAL APPEARS; OR DEGREES AZIMUTH.

COORDINATE 2 CODE (COLUMN 14)

E REFERENCE EAST
W REFERENCE WEST
R RANGE OR RADIUS

** DISTANCE CODE (COLUMNS 15, 16, AND 17)

ROUNDED TO NEAREST FOOT UNLESS DECIMAL APPEARS.

SPECIAL CODE (COLUMN 18)

PARAMETER TO BE USED AS REQUIRED FOR FURTHER ID. TO DIFFERENTIATE REDUNDANT MEASUREMENTS, CHARACTERS ".", "-", OR "+" MAY BE USED. OTHER CHARACTERS ARE EXPLAINED IN DIRECTORY.

BLANK (COLUMN 19)

RESERVED

PARAMETER (COLUMN 20)

INITIALLY THE SAME AS COLUMN 5.

* For tests 11-38 and 46-57, columns 10, 11, 12, and 13 are height of burst. For tests 11-38, HOB is measured in thousandths of a foot; i.e., 5.933 feet reads 5933.

** For tests 11-38, Coordinate 2 distance is measured in inches; i.e., 18 inches reads 018.

SECTION 3

DATA MANAGEMENT SYSTEM

The DNA Master File was formed and is maintained by the DATA/70S Data Base Management and Processing System. The DATA/70S System is composed of a scientific data base management subsystem (DBMS), a data processor subsystem (MAC/RAN), and a display subsystem. The DATA/70S design comprises five main subprocessors (EDITOR, UPDATE, EXTRACT, MAC/RAN, and POSTPROC) plus the Master File and the Directories, as depicted in Figure 4.

Raw data on digital magnetic tape are reformatted and merged with auxiliary punched-card information (including the 20-character Identification Indicator described in Section 2.3, and other useful information) via the EDITOR subprocessor or module. The reformatted and merged data are then passed to the UPDATE module, which adds the data to the Master File (and normalizes it if operating in a classified mode) and simultaneously updates the Directory to include the address of the newly entered data. This procedure comprises the basic Master File buildup, and is called the EDITOR/UPDATE mode of operation. Routine maintenance and other management functions are also performed by EDITOR and UPDATE. These functions are discussed in Volume 2, Appendix B.

After data have been entered into the Master File, they may be retrieved via punched-card instructions that communicate with the EXTRACT module. EXTRACT, in turn, queries the Directory for the address of the requisitioned data and instructs the computer operator at the console to mount the appropriate Master File reel(s). Thereafter, the desired data are retrieved

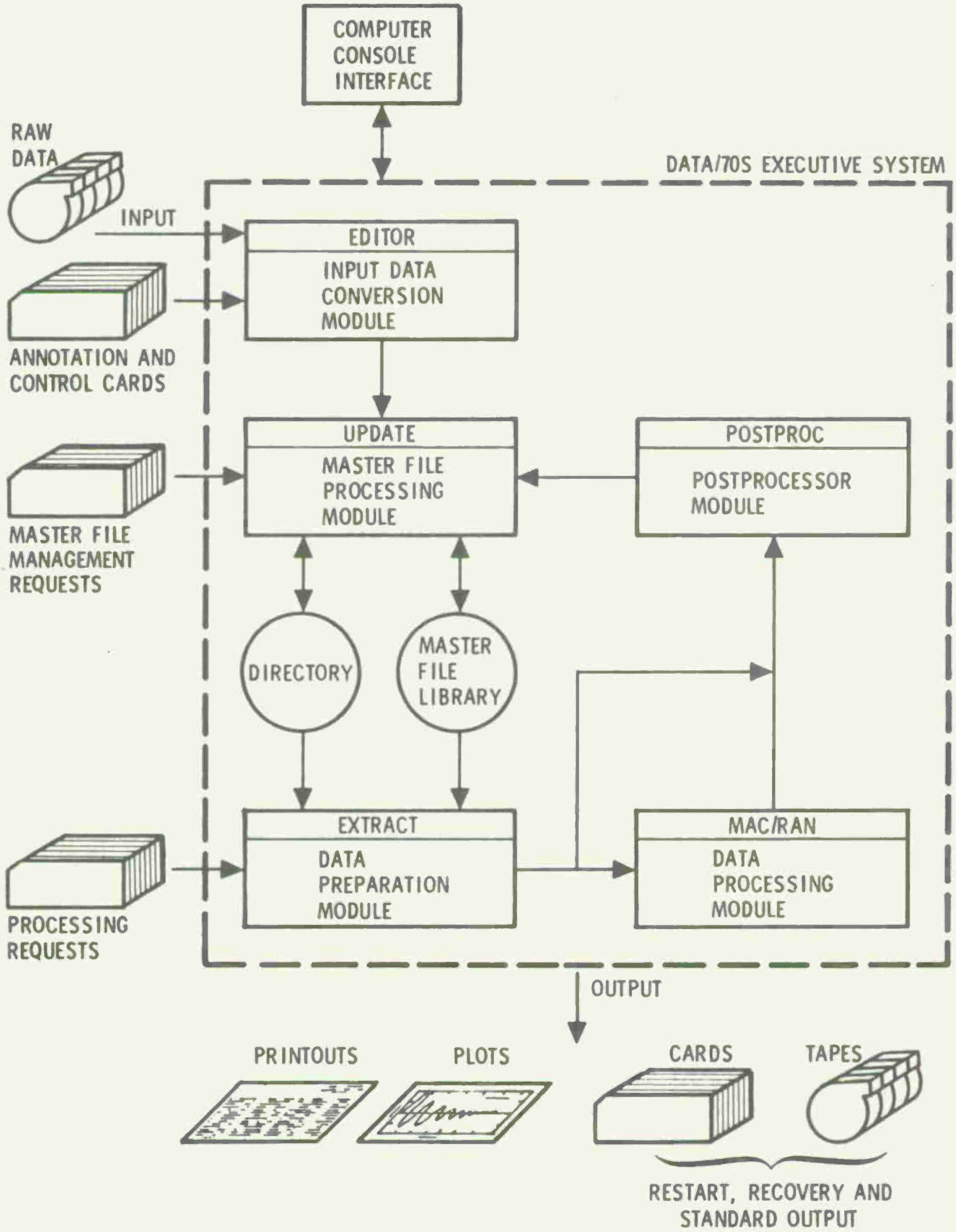

FIGURE 4. THE DATA/70S SYSTEM

and are passed either to the MAC/RAN module for processing or to the POSTPROC module for display. Data retrieval and subsequent processing and display can be accomplished on an individual file basis or in groups of files representing certain classes of data; or the entire Master File can be accessed if desired.

The MAC/RAN module performs various data processing operations as described in Section 4. Processed data that exit from MAC/RAN are passed to POSTPROC (the postprocessor module), which either outputs the data for display, or returns the data to the Master File via the UPDATE module for permanent retention, or both.

The display options are discussed in Section 5. Those desiring a detailed description of the DATA/70S System are referred to Volume 2 for a general synopsis of the system design and to the DATA/70S *Reference Manual*.*

3.1 ACCESS TO THE SYSTEM

The DATA/70S System is an extremely versatile software system that has been utilized for a number of scientific data management and processing tasks, generally involving large blocks of time-dependent data. The system is open-ended in the sense that unlimited quantities of new data can be entered into the Master File. Moreover, all processed data can be returned to the Master File for retention.

In such an arrangement, the Master File can grow to an impractical size if all data are indiscriminately saved. Therefore, some discretion must

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*Agbabian Associates, *DATA/70S Data Base Management and Processing System: Reference Manual*.

be exercised to prevent uncontrolled growth. From time to time, it is also desirable that processed data be purged from the Master File when they are no longer required. During a delete run, care must be exercised to prevent the deletion of useful information.

With these precautions established, the use of DATA/70S by organizations and individuals who have a need for retrieving, processing, and displaying information from the Master File can be addressed. As a test case Physics International accessed, via its remote terminal, data resident in the Master File.* The operation was limited to simple retrieval, which was accomplished with a minimum of effort. With almost as much ease, data could also have been added to the Master File, or they could have been processed after they were retrieved, or even added to the Master File after processing -- all by remote commands. This is, in fact, the usual mode of operation at Agbabian Associates, where the program is accessed through a remote batch terminal over a dedicated communication line. The terminal includes a card reader, line printer, and plotter.

In an unrestricted multiterminal operation, considerable confusion could develop if a number of organizations were independently attempting to retrieve, process, and save data. Accordingly, although the operation of the DATA/70S via remote terminals is a proven concept, such an operation by a number of independent organizations is not considered to be desirable at this time.

**Feasibility of Archiving, at Agbabian Associates, the Ground Motion Data Residing at Physics International Company.*

The preferred mode of operation, immediately available and yielding full-system capability, consists of interfacing with the DATA/70S system via communication with Agbabian Associates. In such an arrangement, the user would have access to the Master File and all important features of DATA/70S by submitting retrieval, processing, and display requests directly.

Thus, the typical user would (1) scan the Directory to decide what data are to be retrieved; (2) select the processing options he requires; (3) determine the display formats of the processed data; and (4) communicate these instructions to Agbabian Associates. The instructions would be executed and the results returned by mail.

SECTION 4

DATA PROCESSING

This section describes the data processing capabilities of the MAC/RAN module in DATA/70S, the formats and languages that command processing performance, and the Identification Indicator update that signifies processed data. The various time series processes that can be performed in MAC/RAN are summarized in Table 4. Complete definitions can be found in the MAC/RAN *Reference Manual*.*

Table 3, in Section 2.3, shows that the Identification Indicator for each new channel of data entered into the Master File is composed of an encoded 20-character alphanumeric array. As data are processed in MAC/RAN in one or more of the options presented in Table 4, entries or modifications are made to characters 19 and 20 of the original 20-character Identification Indicator, and up to 10 new characters are appended to form a new Identification Indicator of up to 30 characters. Thus, any Identification Indicator that contains an entry in character 19 or more than 20 characters altogether must identify processed data. These new characters are added to the original Identification Indicator to provide (1) a permanent record of the processing history associated with each channel of processed data and (2) a unique Identification Indicator entry in the directories for each channel of data that is processed and subsequently returned to the Master File for permanent storage (see Fig. 4).

Part of the MAC/RAN options presented in Table 4 are expanded in Table 5 to show the code words and parameters that form the Processing

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*Agbabian Associates, *Reference Manual, MAC/RAN III*.

TABLE 4. BASIC MAC/RAN OPERATIONS

Input Data Conditioning	Filtering	Frequency Decomposition	Time Domain	Miscellaneous Operations
Calibration Decimation Wild-Point Editing Trend Removal	Butterworth and Chebychev Sine and Tangent Filters • Lowpass • Highpass • Bandpass • Bandreject Exponential Single Tuned Zoom Phase Lock Loop Tracking	Fast Fourier Transform • Real and Imaginary • Gain and Phase Inverse Fast Fourier Transform Power Spectral Density • 3-D Plots Cross-Spectral Density • Real and Imaginary • Gain and Phase Coherence • Ordinary • Partial • Multiple Frequency Response Function • Real and Imaginary • Gain and Phase Shock Spectrum One-Third Octave Band Analysis • Power Spectrum • Spectral Density • Root Mean Square	Histogram Probability Density Function Normality Check Convolution and Detection Auto- and Cross-Correlation Ensemble Mean • Mean Square Sum • Sum of Squares • Variance	Arithmetic • Real • Complex Function Generation • Logarithmic • Exponential • Trigonometric • Gaussian Data Manipulation • Integration • Differentiation • Time Shift

Requests submitted via punched cards to the EXTRACT Module, as shown in Figure 4. Table 5 also presents a brief description of the processing functions associated with each code word and the new characters that are modified or added to the original Identification Indicator as the result of MAC/RAN processing. Because many processing options are available, Table 5 is not presented in its entirety. A complete presentation is included in Volume 2.

For example, suppose the channel of data represented by the original Identification Indicator in Table 3 is subsequently subjected to (1) trend removal, (2) Butterworth lowpass filtering, and (3) integration. The code words from Table 5 corresponding to these operations are DETN, TFILLP, and PINT, respectively. The original 20-character Identification Indicator will then be modified to appear as shown in Figure 5 where the symbols T, L, and I correspond to the code words and the symbol D indicates that the original velocity data (V) were integrated to obtain displacement.

(a) For the original data:	4	2	F	E	V	V	1	0	0	A	1	8	0	R	0	8	5			V			
(b) For the processed data:	4	2	F	E	V	V	1	0	0	A	1	8	0	R	0	8	5			D	T	L	I

FIGURE 5. ORIGINAL AND MODIFIED IDENTIFICATION INDICATOR

4.1 PROCESSING REQUESTS

Communication with DATA/70S for performing data retrieval, data processing, data management, and data disposition is accomplished via punched cards entered as Processing Requests, as indicated in the schematic drawing of Figure 4. Processing Requests consist of (1) Process Control Cards to instruct

TABLE 5. PROCESS CONTROL CARD OPTIONS*

Code Word	Parameters	Character 19	Character 20	Character 21 to 30	Function
		Symbol			
CALBST	Number of calibration steps Physical unit factors	None	None	None	Step calibrate
CALBSTC	Physical unit factors	None	None	None	Continuation of CALBST
CALBSS	Number of calibration steps Physical unit factor	None	None	None	Step and sinusoidal calibration
PWIR	Number of duplicates	None	None	None	Duplication of a file
EDIT	Number of standard deviations Number of points in averaging span Maximum consecutive data replaced Maximum number data replaced	None	None	E	Wild-point editing
DETN	Degree polynomial removed Start time Number of points to fit	None	None	T	Trend removal
DECILP	Decimation index Cutoff frequency Number of points for preload Number of poles	None H	None None	L L	Lowpass tangent filter and decimate; Optionally: filter transfer function gain
FILTLP	Degree polynomial + 1 Decimation index Cutoff frequency Numb...	None	None	L	
			None	S	Delay by one ΔT
	...of filter constant	None	None	L	Exponential filter
PINT	None	None	$P \rightarrow I$ $A \rightarrow V$ $V \rightarrow D$	I	Integration
TFILLP	Degree of polynomial + 1 Decimation index Cutoff frequency Number of points for preload Number of poles	None H	None None	L L	Least squares detrend, Butterworth lowpass tangent filter and decimate; Optionally: filter transfer gain

*See Volume 2 for the complete tabulation.

the system to perform one or more of the processing options presented in Table 5, (2) Management Control Cards to manage the flow of data through the system, (3) Postprocessing Disposition Cards to control the disposition of output data, and (4) File Identification Cards identifying the data to be retrieved from the Master File.

- Process Control Cards

Process Control Cards (PCCs) implement data processing requests by instructing MAC/RAN to perform the data processing options presented in Table 5. One or more PCC statements may be included in any one job stream. The number of such cards depends on the complexity of the data processing that is to be performed on the data. For very complicated job runs, many such statements may be required to achieve the desired results.

- Management Control Cards

Management Control Cards (MCCs) implement specific management functions governing data flow while MAC/RAN is performing the Processing Requests specified by the PCCs. The functions of the MCCs are summarized in Table 6. These management options are required to route data from one point to another as the Processing Requests are fulfilled. Therefore, MCCs are typically interspersed with PCCs. For example, a simple MCC strategy might involve breaking a retrieved data channel into parts, performing different processing options on each part, and joining the segments together again. By including MCCs among the PCCs, various data processes and data management functions can be accomplished together to achieve the desired results. Unlike the Process Control Cards, none of the characters of the Identification Indicator are modified by the Management Control Cards.

TABLE 6. MANAGEMENT CONTROL CARD FUNCTIONS

Code Work	Parameters	Function
DATAIN	Reference number	A location within the Processing Request that receives data from other points
DATAINC	Same	Continuation of DATAIN
DATAOT	Reference number Grouping factor Data channels	A location within the Processing Request from which data are distributed to another point
DATAOTC	Same	Continuation of DATAOT
DATAPP	Grouping factor Data channels	Routes intermediately processed data to POSTPROC
DATAPPC	Same	Continuation of DATAPP
NEWFID	Number of channels	New file Identification Indicator
FBLOCK	Reference number	Subsequent files will be processed according to PCCs following referenced DATAIN
MACR	None	Manual MAC/RAN
BYPS	None	Bypass MAC/RAN

- Postprocessing Disposition Cards

The Postprocessing Disposition Cards (PDCs) are used (1) to control processed data exiting from MAC/RAN or (2) to bypass retrieved data around MAC/RAN solely for display purposes. The PDCs contain the required information for plotting, printing, punching, or taping the processed data, or returning them to the Master File for permanent retention. The various available options are listed in Table 7. The PDCs allow the user to display data in virtually any plotting format required. Up to four plots per page and up to four curves per plot may be requested with any combination of linear or logarithmic coordinates. All plots may be automatically scaled for maximum resolution or they may be plotted to common or selected scales.

TABLE 7. POSTPROCESSING DISPOSITION FUNCTIONS

Code Word	Parameters	Function
DISP	Number of files Grouping for saved files for plotted files for printed files for punched files for taped files	Instructs disposition of output from a process string
FILEMA FILEPL FILEPR FILEPU FILETP	Files for Master File for plotting for printing for punching for taping	Files to be routed
FRAM	Graph format	Number and type of plots per frame
SCALXA SCALXAC SCALYA SCALYAC	Scale factors Same Scale factors Same	Scales plots on x axis Continuation of SCALXA Scales plots on y axis Continuation of SCALYA
COMMXA COMMYA	Plots having common x scales Plots having common y scales	Common scales for x axis Common scales for y axis

- File Identification Cards

File Identification Cards (FICs) specify via the Identification Indicator which channels of data are to be retrieved from the Master File. The FICs contain fields that instruct DATA/70S on the start and stop time (or frequency) of data to be retrieved and the start and stop time (or frequency) of the data to be plotted. One file or many files may be extracted from the Master File depending on the literal use of the Identification Indicator. For example, just one file may be retrieved by exactly card punching one of the Identification Indicators from the Directory. On the other hand, the entire original Master File can be extracted by punching in asterisks for each of the 20 locations in the Identification Indicator field. Less extensive extraction can be accomplished by using the asterisk notation discriminately.

A complete string of commands comprising Process Control, Management Control, Postprocessing Disposition, and File Identification Cards are illustrated in Figure 6. The Process Control and Data Management Control Cards may be interspersed and grouped together as shown. Similarly, the File Identification and Management Control Cards may also be interspersed and grouped. The LAST and END cards punctuate the string.

4.2 ILLUSTRATIVE EXAMPLE

A simple example will serve to illustrate the use of the four types of Processing Requests that have been described. In the case to be considered, two MINERAL LODE velocity records will be processed and plotted. The first record will be tangent lowpass filtered, decimated, and integrated. The second record will be front-end detrended,* and also tangent lowpass filtered, decimated, and integrated. The processed data will be plotted on a single page consisting of

*Front-end detrending consists of the subtraction from the entire file a polynomial fitted to the lead-in segment measured from zero time to first shock arrival.

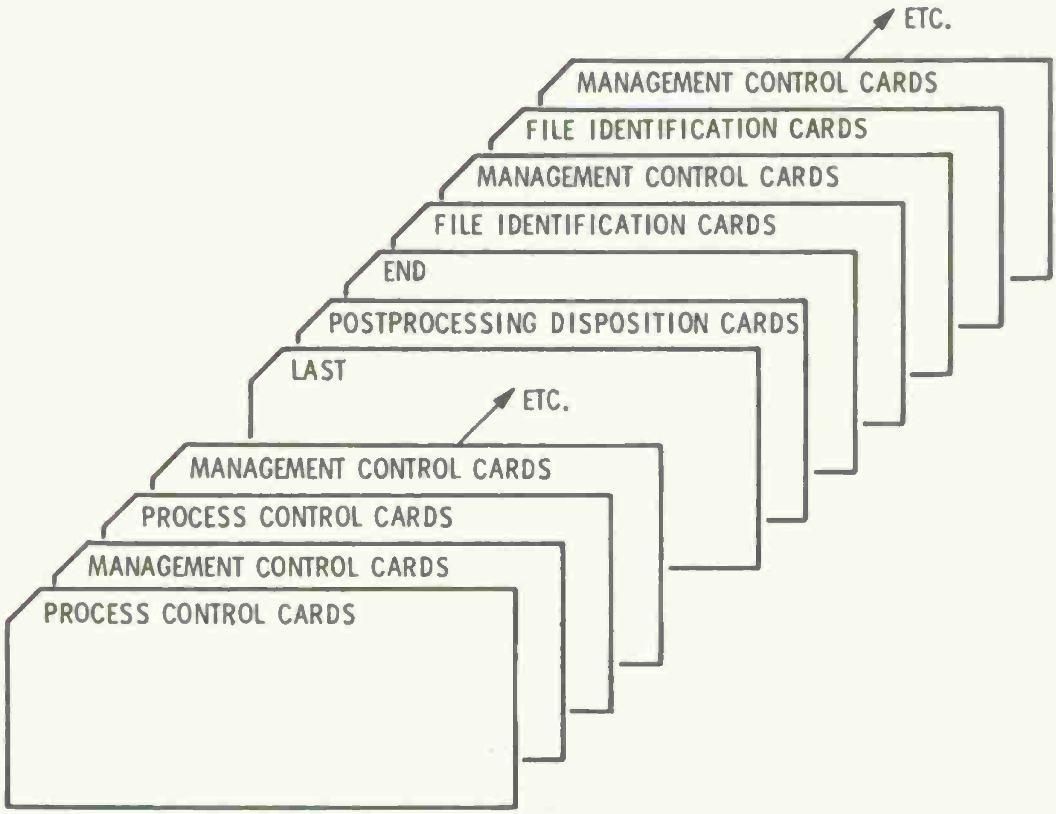

FIGURE 6. COMPOSITION OF PROCESSING REQUESTS

four vertically stacked graphs. The first two graphs will consist of the first processed record and its integration; the last two graphs will show the second processed record and its integration.

Figure 7 presents the Processing Request Cards required to complete the prescribed work. The job run consists of 23 cards in which all four card types (PCCs, MCCs, PDCs, and FICs) are included. The data to be retrieved from the Master File are sampled at 48,000 samples per second (sps). Therefore, the corresponding time increments are 0.020833 msec.

CARD NO.	CARD TYPE	CODE WORD	FIELD 1	FIELD 2	FIELD 3	FIELD 4	FIELD 5
1	MCC	DATAIN	1.				
2	PCC	TFILLP		10.	1500.		
3	PCC	PWIR	2.				
4	MCC	DATAOT	3.	2.	2.		
5	PCC	PINT					
6	MCC	DATAOT	3.				
7	MCC	DATAIN	2.				
8	PCC	DETN			240.		
9	PCC	TFILLP		10.	1500.		
10	PCC	PWIR	2.				
11	MCC	DATAOT	3.	2.	2.		
12	PCC	PINT					
13	MCC	DATAOT	3.				
14	MCC	DATAIN	3.				
15	PCC	PWIR	1.				
16	PDC	DISP			4.		
17	PDC	FRAM	110.	210.	310.	410.	
18		LAST					
19	MCC	FBLOCK			1.		
20	FIC	42FEVV100A180R075	V			.025	
21	MCC	FBLOCK			2.		
22	FIC	42FEVV100A180R085	V			.025	
23		END					

FIGURE 7. AN EXAMPLE OF A PROCESSING REQUEST JOB RUN

Each card of the Processing Request string is described below, and can be correlated with the example in Figure 7, and Tables 5, 6, and 7:

Card 1 -- DATAIN: DATAIN statements read, in sequence, data from one or more of the four following options: (1) from previous PCCs, (2) from DATAOT transfers, (3) from FBLOCK transfers, and (4) from FICs. Since there are no previous PCCs or DATAOT transfers, this DATAIN card is an instruction to retrieve the FIC data channel identified on Card 20 following the first FBLOCK card (Card 19). Reference Number 1 in Field 1 of Card 1 corresponds to Reference Number 1 in Field 3 of Card 19. It is noted at this time that only 25 msec of data (Field 4 of Card 20) are to be retrieved.

Card 2 -- TFILLP: The record (identified in Card 20) is to be lowpass filtered with a nominal 6-pole (blank in Field 5) tangent Butterworth filter having a cutoff frequency at 1500 Hz (Field 3). The record is then decimated by a factor of 10 (Field 2), i.e., the sampling rate is reduced from 48,000 to 4800 sps. Blanks in Fields 1 and 4 mean that no detrending or filter preloading is to be accomplished.

Card 3 -- PWIR: The processed record is to be duplicated once to create two files of the same data that are passed to the following card.

Card 4 -- DATAOT: The second file (Field 3) of this group of two files (Field 2) is to be routed to the third (Field 1) DATAIN location (Card 14).

Card 5 -- PINT: The first file of the group from Card 3 is to be integrated.

Card 6 -- DATAOT: The integrated file is to be routed to Card 14. Blanks in Fields 2 and 3 mean that all data are to be transferred (in this case just a single file is available.)

Card 7 -- DATAIN: The data following the second FBLOCK statement (Card 21) are to be retrieved. Again, the retrieved file is to be limited to 25 msec of data.

Card 8 -- DETN: The mean (blank in Field 1) of the first 240 points (Field 3) of data beginning at time zero (Field 2) is to be calculated and subsequently subtracted from the entire file.

Card 9 -- TFILLP: The detrended data are to be filtered and decimated as in Card 2.

Card 10 -- PWIR: A duplicate is to be made as in Card 3, and the two files are passed to the following card.

Card 11 -- DATAOT: The duplicate is to be routed to Card 14, as in Card 4.

Card 12 -- PINT: The output from Card 9 is to be integrated.

Card 13 -- DATAOT: The integration is to be sent to Card 14, as in Card 6.

Card 14 -- DATAIN: The four files obtained from the DATAOT statements on Cards 4, 6, 11, and 13 are to be collected here.

Card 15 -- PWIR: The four files from Card 14 are to be passed to Card 16 for disposition.

Card 16 -- DISP: The four files are to be plotted (Field 3) as described on page 36. None of the files are to be saved (Field 2), printed (Field 4), punched (Field 5), or taped (Field 6, not shown in Fig. 7). A blank in Field 1 means that all files arriving at Card 16 are to be considered, i.e., none are to be rejected.

CARD 17 -- FRAM: The first, second, third, and fourth graphs (first numeral in each of the four fields) are to consist of one graph each (second numeral, the digit 1 common to all four fields) and all are to be plotted in Cartesian coordinates (the zero digit common to all four fields).

Cards 18 and 23 -- LAST and END: punctuation of the job run.

Cards 19 through 22: These cards have been described above.

The output from this Processing Request is discussed next.

SECTION 5

DATA DISPLAY

Processed data may be saved, plotted, printed, punched, and copied on tape. However, for most applications the plotted format is the most useful. Accordingly, this output option is discussed in some detail in this section. The remaining output options are presented in the DATA/70S *Reference Manual*.

Figure 8 presents the plotted output from the Processing Request shown in Figure 7. The plot contains graphic information on the left and tabular data on the right. The latter provides a description of the graphs, statistical information, and a historical record of the processing applied to the data. For example, the Identification Indicator 42FEVV100A180R085 DTLI for Curve 4 indicates that the original data (whose Identification Indicator is shown on Card 22 of Figure 7) have been detrended, filtered, and integrated according to the code words DETN, TFILLP, and PINT, whose symbols (see Table 5) are T, L, and I, respectively. Also, character 20 changed from a V to a D in accordance with Table 5, indicating integration of the data.

The tabulated output for Curve 4 in Figure 8 presents the original measurement number, 85-S-UV, and the originating agency WES. Lines 3 and 4 present entries that have the following meanings:

4.8×10^{3}	= sampling rate in samples per second
-8.6513×10^{-2}	= minimum amplitude in entire file
2.3044×10^{-2}	= maximum amplitude in entire file
0.0	= minimum time in plotted segment of file
2.4996×10^{-2}	= maximum time in plotted segment of file
-8.6513×10^{-2}	= minimum amplitude in plotted segment of file
2.3044×10^{-2}	= maximum amplitude in plotted segment of file

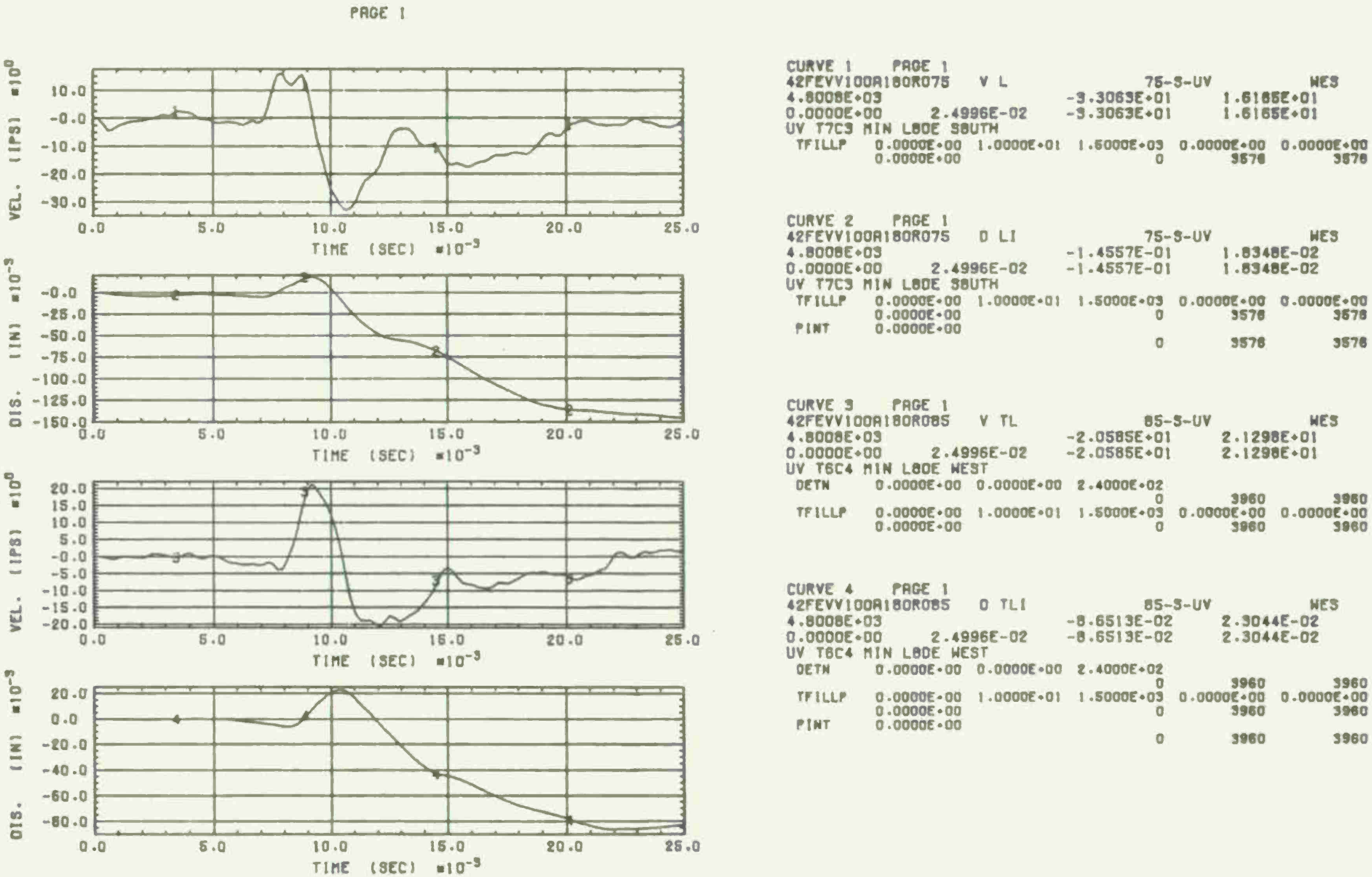

FIGURE 8. EXAMPLE OF PLOTTED OUTPUT

The entries following the code words DETN, TFILLP, and PINT correspond to the input data punched on Cards 8, 9, and 12, respectively, in Figure 7. Additional comments, selected by the user and input to the EDITOR module when the Master File was constructed, appear on Line 5.

This example problem shows the stacking of 4 plots on the same page. Generally, each graph can have various combinations of linear and logarithmic scales. Graphs can share common x- and y-axis scales, whose ranges are either selected automatically by the system (autoranging) or are specified by the system user. Each graph can contain as many as 4 curves (overlays). By combining these various options, 16 curves could be presented on a single page of plotted output.

The prime purpose of the plot package in DATA/70S is to provide versatility for the analyst. There is virtually no limitation to the various combinations of plots that can be utilized. Spectral, temporal, and statistical information can be plotted in an order and format that facilitate study and, for presentation purposes, that minimize the organization in report writing and data reporting.

SECTION 6

SELECTED BIBLIOGRAPHY

The bibliography presented in this section is principally a subset of documents cataloged by DASIAC, the DoD Nuclear Information and Analysis Center, for the high-explosive test events relevant to the DNA Master File.

The bibliography is presented chronologically by major test event. Within each major event, the bibliographical lists are presented alphabetically. When some test events included two or more subevents, abbreviations in the right-hand column indicate the specific subevents discussed in a document. This arrangement minimizes the size of an already very large bibliography.

In order to present a bibliography of realistic size, some judgment was necessary in determining documents to be listed. Generally, the list includes entries pertaining to or even loosely related to ground-motion, air-blast, and structure-response phenomena. For example, documents discussing test mechanizations and cratering were included, whereas those discussing electromagnetic pulse radiation or ejecta were omitted.

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Fenrick, W.J. and Naylor, R. *Cable Noise Generated by Blast Waves,* Suffield Tech. Note 293. Ralston, Alberta, Canada: Defence Research Establishment Suffield, 6/71. (AD 890 701)

Giglio-tos, L. and Pettit, B.A. *Fundamental Blast Studies, Project Officer's Report, Project LN-101, MIDDLE NORTH Series, PRAIRIE FLAT Event,* POR-2100, WT-2100. Aberdeen, MD: Army Ballistic Research Labs, 3/71. (AD 884 307L)

Hadfield, J.A. and Jones, G.D. *Data Analysis Report, Tilt and Rotation of Vertical Cylindrical Structures,* AFWL TR-73-101. Seattle, WA: Boeing Co., 7/73. (AD 913 036L)

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Jones, G.D. *Ground Displacement Study, Operation PRAIRIE FLAT, Project Officer's Report, Project LN 317*, WT-2110. Seattle, WA: Boeing Co., 10/70. (AD 875 778)

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Murrell, D.W. *Operation DIAL PACK, Project LN 305, Earth Motion and Stress Measurements in the Outrunning Region*, AEWES TR-N-73-4. Vicksburg, MS: Army Engineer Waterways Experiment Station, 5/73. (AD 762 172)

Needham, C.E. *PRAIRIE FLAT Airblast Calculations*, AFWL TR-69-4. Kirtland AFB: Air Force Weapons Laboratory, 2/69. (AD 848 591)

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Robinson, R.R. *Comparison of a Soil/Structure Interaction Formulation with Experimental Data for the Safeguard Power Plant*, Vols. I and II, IITRI-J6197. Chicago: IIT Research Institute, 9/71. (AD 894 678L)

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Ross, J.F. *System and Procedures for Measuring Blast Wave Density in a 500-Ton TNT Surface Burst*, Suffield Tech. Note 258. Ralston, Alberta, Canada: Defence Research Establishment Suffield, 5/71. (AD 890 855)

Sauer, F.M. *Summary Report on DISTANT PLAIN Events 6 and 1A Ground Motion Experiments*, DASA 2587, PGU 5645. Menlo Park, CA: Stanford Research Institute, 10/70. (AD 879 825L)

Vincent, C.T. *Earth Pressure and Ground Shock Profile Measurements, Operation PRAIRIE FLAT, Project Officer's Report, Project LN 304*, POR-2113, WT-2113, PGU-7144. Menlo Park, CA: Stanford Research Institute, 5/69. (AD 881 904)

Yang, I. *Ground Surface Waves*, TT P-260-73-1, DNA 3022F. Pasadena, CA: Tetra Tech, Inc., 2/73. (AD 756 256)

Zelasko, J.S. and Baladi, G.Y. *Free-Field Code Predictions versus Field Measurements, A Comparative Analysis for the PRAIRIE FLAT Event*, Misc. Paper S-71-6. Vicksburg, MS: Army Engineer Waterways Experiment Station, 3/71. (AD 722 403)

MINE SHAFT

Albritton, G.E.; Balsara, J.P.; and Baver, D.M. *Response of Deep Two-Way-Reinforced and Unreinforced Concrete Slabs to Static and Dynamic Loading, Report 4, MINE SHAFT Series, MINE UNDER Event, Program 3, Structural Response Deep-Slab Tests*, N-69-2. Vicksburg, MS: Army Engineer Waterways Experiment Station, 11/69. (AD 862 558) MU*

*MU = Mine Under

MINE SHAFT (CONTINUED)	EVENT
Browder, L.E. *Structural Response of an Unlined Vertical Cylinder in Operation MINE ORE*, AFWL TR-69-64. Kirtland AFB: Air Force Weapons Laboratory, 9/69. (AD 861 018)	MO*
Browder, L.E. *Structural Response of Unlined Vertical Cylinders in Granite to 100-Ton TNT Detonation*, AFWL TR-70-74. Kirtland AFB: Air Force Weapons Laboratory, 12/70. (AD 881 368L)	MR*
Calhoun, D.E. *Rock Properties Test for Project MINE SHAFT*, AFWL TR-70-24. Kirtland AFB: Air Force Weapons Laboratory, 10/70. (AD 877 723)	MU,* MO, ML,* MR
Carleton, H.D. *Digital Filters for Explosion Effects Analysis*, TR-N-71-7. Vicksburg, MS: Army Engineer Waterways Experiment Station, 6/71.	MO
Cooper, H.F., Jr. *Empirical Studies of Ground Shock and Strong Motions in Rock*, DNA 3245F, RDA TR-3601-002. Santa Monica, CA: Research and Development Associates, 10/73. (AD 916 718L)	MR, ML
Cooper, H.F., Jr.; Brode, H.L.; and Leigh, G.G. *Some Fundamental Aspects of Nuclear Weapons*, AFWL TR-72-19. Kirtland AFB: Air Force Weapons Laboratory and Santa Monica, CA: Research and Development Associates, 3/72. (AD 741 876)	MR
Davis, L.K. *Events MINE UNDER and MINE ORE, MINE SHAFT Series, Subtask N121, Crater Investigations*, N-70-8. Vicksburg, MS: Army Engineer Waterways Experiment Station, 3/70. (AD 871 472)	MU, MO
Davis, L.K. and Carnes, B.L. *Cratering Effects of a 100-Ton TNT Detonation of Granite, Operation Mine Shaft*, MS-2151, AEWES Misc. Paper N-72-1. Vicksburg, MS: Army Engineer Waterways Experiment Station, 2/72. (AD 891 579L)	MR, MO
Drake, J.L. *Mathematical Model for Describing Stress Wave Propagation in a Jointed Rock Mass*, AEWES TR-N-73-7. Vicksburg, MS: Army Engineer Waterways Experiment Station, 10/73. (AD 769 582)	ML
Dysart, R.Q.; Gorman, J.V.; and Maggard, S.P. *Methodology Investigation of Blast Test*. White Sands Missile Range: Army Missile Test and Evaluation Directorate, 7/73. (AD 913 739L)	MR
Hadfield, J.A. and Jones, G.D. *Data Analysis Report, Tilt and Rotation of Vertical Cylindrical Structures*, AFWL TR-73-101. Seattle: Boeing Company, 7/73. (AD 913 036L)	MR , MO
Hanes, F.P. *Operation MINE SHAFT, an Electronic System for Precise Timing and Firing Control of Explosive Tests, Final Report*, MS-2169. Vicksburg, MS: Army Engineer Waterways Experiment Station, 6/70. (AD 872 246)	MU , MO ML , MR
Hardrock Silo Development Program, SIMDEP Data Review, Test Report General, CDRL A-114. Los Angeles: Bechtel Corporation, 5/70. (AD 872 229L)	MO
Hoffman, H.V. and Vincent, C.T. *Ground Motion and Close in Stress Measurements on MINE SHAFT, SS203*, DASA 2320, PGU 7300. Menlo Park, CA: Stanford Research Institute, 8/69. (AD 856 489L)	MO, MU

*MO = Mine Ore ML = Mineral Lode
MU = Mine Under MR = Mineral Rock

MINE SHAFT (CONTINUED)	EVENT
Joachim, C.E. *MINE SHAFT Series, Events MINE UNDER and MINE ORE, Subtask SS222, Ground Motion and Stress Measurement,* TR-N-72-1. Vicksburg, MS: Army Engineer Waterways Experiment Station, 1/72. (AD 891 597L)	MU*, MO*
Jones, G.D. and Davies, F.W. *Project Officer's Report -- Subtask SS101, Permanent Displacements in Rock, Operation MINE SHAFT, MINE ORE Event,* DASA 2276. Seattle: Boeing Company, 5/69. (AD 853 458L)	MO
Kochly, J.A. and Stubbs, T.F. *Particle Velocity Measurements from a 100-ton TNT Detonation on Granite, MINE SHAFT Series, MINERAL ROCK Event, Project Officer's Report,* POR-2162, WT-2162. San Leandro, CA: Physics International Company, 5/71. (AD 886 129L)	MR*
Kolb, C.R. *Geological Investigation of the MINE SHAFT Sites, Cedar City, Utah, Operation MINE SHAFT,* MS-2170, S-70-22. Vicksburg, MS: Army Engineer Waterways Experiment Station, 8/70. (AD 876 514)	MO, MU MR, ML*
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Lamping, N.E. *Determination of the Geologic Effects on Nuclear Crater Formation by High Explosive Simulation Techniques,* AU 1515-74. Maxwell AFB: Air University, 5/74. (AD 920 550L)	
Lieberman, P., et al. *Close-in Pressure and Displacement Measurements in MINE ORE,* DASA 2321, J-6158-FR. Chicago: IIT Research Institute, 8/69. (AD 859 358L)	MO
Linderman, R.B. *Hardrock Silo Development Program, Test Report General SIMDEP Data Review,* CDRL A-114. San Leandro, CA: Physics International Company; and Los Angeles: Bechtel Corporation, 7/70. (AD 872 229L)	MO
Maxwell, D. and Moises, H. *Prediction Calculations of MINE UNDER and MINE ORE,* PIFR 087-III-B, DASA 2526. San Leandro, CA: Physics International Company, 2/71. (AD 721 369)	MU , MO
Meyer, J.W. and Rooke, A.D. *MINE SHAFT Series: Events MINE UNDER and MINE ORE,* N-69-2. Vicksburg, MS: Army Engineer Waterways Experiment Station, 9/69. (AD 860 530L)	MO, MU
Murrell, D.W. *Operation MINE SHAFT, MINERAL ROCK Event, Far-Out Ground Motions from a 100-Ton Detonation over Granite,* TR-N-72-6. Vicksburg, MS: Army Engineer Waterways Experiment Station, 4/72. (AD 741 771)	MR
Murrell, D.W. *Operation DIAL PACK, Project LN-3051 Earth Motion and Stress Measurements in the Outrunning Region,* AEWES TR-N-73-4. Vicksburg, MS: Army Engineer Waterways Experiment Station, 5/73. (AD 762 172)	MO, MU, MR

*MO = Mine Ore
MU = Mine Under
ML = Mineral Lode
MR = Mineral Rock

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	EVENT
Murrell, D.W. and Carleton, H.D. *Ground Shock from Underground and Surface Explosions in Granite, Operation MINE SHAFT*, MS-2159, MS-2160, AEWES TR-N-73-2. Vicksburg, MS: Army Engineer Waterways Experiment Station, 4/73. (AD 910 114L)	MR*, ML*
Needham, C.E. and Burghard, T.H. *Air Blast Calculations, Event MINE UNDER*, AFWL TR-69-105. Kirtland AFB: Air Force Weapons Laboratory, 10/69. (AD 864 280)	MU*
Patterson, A.M., et al. *Fireball and Shock Wave Anomalies*, N2-TR-1-70, DASIAC SR-105. Santa Barbara, CA: DASA Information and Analysis Center, 8/70. (AD 875 397L)	MU, MO*
Pfefferle, W. and Smith, C.R. *Phase I Flat Jack Tests, Technical Report*, TR-0059, SAMSO TR-70-381. San Bernardino, CA: Aerospace Corporation, 10/70. (AD 715 264)	MR
Reaugh, J.E. *Computations for MINE ORE/MINERAL ROCK*, PIFR 252, DNA 2852F. San Leandro, CA: Physics International Company, 4/72. (AD 742 835)	MO, MR
Rooke, A.D., Jr.; Carnes, B.L.; and Davis, L.K. *Cratering by Explosions -- A Compendium and an Analysis*, AEWES TR-N-74-1. Vicksburg, MS: Army Engineer Waterways Experiment Station, 1/74.	MU, MO, MR
Smith, C.R.; Langley, N.P.; and Pfefferle, W. *Surface/Subsurface Free-Field Displacement and Rotation Measurement Experiment, Operation MINE SHAFT, MINERAL ROCK Event*, TOR 0172-(S2320-01)-3. San Bernardino, CA: Aerospace Corporation, 10/71.	MR
Strange, J.N. and McAnally, W.H., Jr. *Surface Effects and Cavity Resulting from the Detonation of a 16-ton Charge Deep in Granite, Operation MINE SHAFT*, MS-2157, WES N-70-4. Vicksburg, MS: Army Engineer Waterways Experiment Station, 7/70. (AD 874 685)	ML
Stubbs, T. and Kochly, J.A. *Ground Motion Measurements and Explosion Source Diagnostics on MINERAL LODE, SX30221, Project Officer's Report, MINE SHAFT Series, MINERAL LODE Event*, POR 2161, WT-2161, 21-165. San Leandro, CA: Physics International Company, 5/71. (AD 884 086)	ML
Teel, G.D. *Air Blast Measurements*, BRL R-1477. Aberdeen Proving Ground, MD: Army Ballistic Research Laboratories, 2/70. (AD 869 005)	MU , MO
Teel, G.E. *Air-Blast Measurements from a 100-Ton Detonation over Granite, MINERAL ROCK Event, MINE SHAFT Series*, BRL 1502, MS-2165. Aberdeen Proving Ground, MD: Army Ballistic Research Laboratories, 10/70. (AD 878 551L)	MR
Watt, J.M., Balsara, J.P., and Albritton, G.E. *Response of Deep Two-Way Reinforced Concrete Slabs to Static and Dynamic Loading, Report 6, MINE SHAFT Series, MINERAL ROCK Event, Program 3, Structural Response Studies, Deep Slab Tests, Phase 2*, N-69-2. Vicksburg, MS: Army Engineer Waterways Experiment Station. 9/70. (AD 877 405L)	MR

*MO = Mine Ore ML = Mineral Lode
MU = Mine Under MR = Mineral Rock

Anderson, J.H.B. "Canadian Air-Blast Measurements," in *Event DIAL PACK Symposium Report*, Vol. I. Ralston, Alberta, Canada: Defence Research Establishment Suffield, 3/71. (AD 909 668)

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Anderson, J.H.B. and Fenrick, W.J. *Canadian Air-Blast Overpressure Measurements on Event DIAL PACK*, Suffield TN-296, Ralston, Alberta, Canada: Defence Research Establishment Suffield, 6/72. (AD 904 960)

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Event DIAL PACK Preliminary Report, Vols. 1 and 2, DASA 2606-1, DASIAC SR-115. Santa Barbara, CA: DASA Information and Analysis Center, 5/71. (AD 884 879L and -880L)

Fenrick, W.M. and Naylor, R. *Cable Noise Generated by Blast Waves*, Suffield TN-293. Ralston, Alberta, Canada: Defence Research Establishment Suffield, 6/71. (AD 890 701)

Ferritto, J.M. *Dynamic Response of an Isolated Floor Slab -- Results of an Experimental Test in Event DIAL PACK*, TR-R-726. Port Hueneme: Naval Civil Engineering Laboratory, 5/71. (AD 885 576L)

Ferritto, J.M. "Response of an Isolated Floor Slab -- Results of an Experiment in Event DIAL PACK," *Shock and Vibration Bulletin*, 42:2 (January 1972).

*Fourteenth Meeting of Panel N-2 (Blast, Shock, and Thermal), (The Technical Co-operation Programme.*Foulness Island, Southend-on-Sea, England: Atomic Weapons Research Establishment, 6/71.

Fugelso, L.E. and Fields, S.F. *DIAL PACK Blast Directing Experiment, Project LN 105*, GARD PROJ. 1506, DNA 2756F. Niles, IL: General American Transportation Corporation, Research Division, 1/72. (AD 735 147)

Fugelso, L.E.; Fields, S.F.; and Byrnes, W.J. *DIAL PACK Blast Directing Experiment*. Niles, IL: General American Transportation Corporation, Research Division, 1/72.

Giglio-Tos, L. "Fundamental Air-Blast Measurements, Project LN101," in *Event DIAL PACK Symposium Report*, Vol. 1. Aberdeen Proving Ground, MD: Army Ballistic Research Laboratories, 3/71. (AD 908 668)

Giglio-Tos, L. *Fundamental Blast Studies, MIDDLE NORTH Series, DIAL PACK Event, Project Officer's Report -- Project LN101*, POR-6744, WT-6744. Aberdeen Proving Ground, MD: Army Ballistic Research Laboratories, 12/72. (AD 753 805)

Johnson, E. and Vellozzi, J.W. *Evaluation of Experimental Data for PARB from Event DIAL PACK*, PAR-CRI-A&W-109. New York: Ammann and Whitney. Consulting Engineers. 10/72. (AD 913 297L)

Johnson, O. *Anomalous Blast Wave Propagation from a Large Yield TNT Explosion (Event DIAL PACK)*, Suffield TN-194. Ralston, Alberta, Canada: Defence Research Establishment Suffield, 3/71. (AD 883 353)

Keefer, J.H. *Event DIAL PACK, Preparation of Experimental and Requirements Plans*, DASIAC SR-98. Santa Barbara, CA: General Electric Company/Tempo, 7/69.

Lambert, A.P.R. *Preparation of Charge Base and Stacking of 500-Ton TNT Charge Event MIXED COMPANY*. Ralston, Alberta, Canada: Defence Research Establishment Suffield, 2/73.

Lamping, N.E. "Recent Near-Surface High Explosive Cratering Experiments," in *Strategic Structure Vulnerability/Hardening Long Range Planning Meeting, 15-17 May 1973*, Vol. 1. Kirtland AFB: Air Force Weapons Laboratory, 5/73. (AD 915 948L)

Malthan, J.A. *Data and Correlation Analysis for Structural Response Measurements -- Event DIAL PACK*, R-7124-4-2484. El Segundo, CA: Agbabian Associates, 1/73. (AD 910 209L)

McGrath, R.K. *Dynamic Response of Concrete Arch Bunkers, Event DIAL PACK Project LN 314A*, TR-N-71-8. Vicksburg, MS: Army Engineer Waterways Experiment Station, 7/71. (AD 884 842L)

Mellsen, S.B. *Measurement of Drag on Cylinders by the Free-Flight Method in Event DIAL PACK*. Ralston, Alberta, Canada: Defence Research Establishment Suffield, 1/72. (AD 891 828)

Meyer, J.W. "Crater and Ejecta Studies, Project LN 301," *Event DIAL PACK Symposium Report*, Vol. 2. Vicksburg, MS: Army Engineer Waterways Experiment Station, 3/71. (AD 909 669)

Murrell, D.W. "Earth Motion and Stress Measurements, Projects LN302-LN305," in *Event DIAL PACK Symposium Report*, Vol. 2. Vicksburg, MS: Army Engineer Waterways Experiment Station, 3/71. (AD 909 669)

Murrell, D.W. *Operation DIAL PACK, Project LN 305, Earth Motion and Stress Measurements in the Outrunning Region*, AEWES TR-N-73-4. Vicksburg, MS: Army Waterways Experiment Station, 5/73. (AD 762 172)

Murrell, D.W. *Earth Motion and Stress Measurements, Project LN 302 Operation DIAL PACK*, AEWES TR-N-74-3. Vicksburg, MS: Army Engineer Waterways Experiment Station, 4/74. (AD 779 505)

Needham, C.E. "Theoretical Air-Blast Calculations," in *Event DIAL PACK Symposium Report*, Vol. 1. Kirtland AFB: Air Force Weapons Laboratory, 3/71. (AD 909 668)

Needham, C.E. "Theoretical Computer Techniques for Predicting Nuclear Blast Phenomena and Effects, Air-Blast Effects, in *Fourteenth Meeting of Panel N-2 (Blast, Shock, and Thermal), (The Technical Co-operation Programme)*. Foulness Island, Southend-on-Sea, England: Atomic Weapons Research Establishment, 6/71.

Patterson, A.M. "Blast Anomalies Study," in *Event DIAL PACK Symposium Report*, Vol. 1. Defence Research Establishment Pacific, 3/71. (AD 909 668)

DIAL PACK (CONTINUED) | EVENT

Patterson, A.M. *Fireball and Shock Wave Anomalies Observed on Event DIAL PACK*, Suffield TN-300. Ralston, Alberta, Canada: Defence Research Establishment Suffield, 6/71. (AD 890 507)

Rooke, A.D., Jr.; Carnes, B.L.; and Davis, L.K. *Cratering by Explosions -- a Compendium and an Analysis*, AEWES TR-N-74-1. Vicksburg, MS: Army Engineer Waterways Experiment Station, 1/74.

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Supplement to Dynamic Response of an Isolated Floor Slab -- Results of an Experimental Test in Event DIAL PACK, NCEL TR-R-726S. Port Hueneme: Naval Civil Engineering Laboratory, 5/71. (AD 885 577L)

Takahashi, S.K. *Buried Fuel Capsule -- Comparison of Three-Dimensional Computer Data with Experimental Data*, NCEL TR-798. Port Hueneme: Naval Civil Engineering Laboratory, 9/73.

Welch, R.E. *Test/Analysis Correlations for High Explosive Tests of Strategic Structures*, J6234, DNA 2971F. Chicago, IL: IIT Research Institute, 11/72. (AD 905 178L)

MINE THROW

Buckingham, A.C., et al. *Calculation of Cactus Ground Motion and Design of the MINE THROW II Charge*, Vol. 3, DNA 3141F-3. San Leandro, CA: Physics International Company, 8/73. (AD 912 650L) | II

Carnes, B.L. and Conway, J.A. *Event MINE THROW I -- Cratering Effects on a Multiton Near-Surface Detonation in Desert Alluvium*, AEWES TR N-73-3. Vicksburg, MS: Army Engineer Waterways Experiment Station, 5/73. (AD 910 941L) | I

McKay, M.W., et al. *Development of Preliminary Design Data for the MINE THROW II Event*, PIFR 383, DNA 30372. San Leandro, CA: Physics International Company, 3/73. (AD 908 766L) | II

Stubbs, T.F., et al. *MINE THROW I -- A Cratering and Ground Motion Simulation Technique*, DNA 3665F, PIFR 374. San Leandro, CA: Physics International Company. 7/74. (AD 921 229L) | I

MIDDLE NORTH

Anderson, J.H.B. *Canadian Air-Blast Measurements on Event MIXED COMPANY*, DRES TN-337. Ralston, Alberta, Canada: Defence Research Establishment Suffield, 7/73. (AD 914 598) | MC*

*MC = Mixed Company

MIDDLE NORTH (CONTINUED)	EVENT
Ballard, R.F., Jr. and Leach, R.E. *Strong-Motion Seismic Measurements; MIDDLE NORTH Series, MIXED COMPANY Event.* Vicksburg, MS: Army Waterways Experiment Station, 7/73. (AD 914 012L)	MC*
Bliamptis, E.E. *Operation MIXED COMPANY/Shot MC-III, Operation MIDDLE GUST/Shot MG-V Project LN 307, Soil Resistivity Measurements,* AFCRL TR-74-0035. L.G. Hanscom Field, MA: Air Force Cambridge Research Laboratories, 74. (AD 775 162)	MC-III, MG-V*
Brace, W.F. *Static Deformation of Rocks to 20-kb Confining Pressure,* DNA 3126F. Cambridge, MA: Massachusetts Institute of Technology, 9/72. (AD 769 776)	MC
Bunker, R.B. and Doran, J.A. *Impedance Mismatch High-Stress Transducer (IMHST),* AFWL TR-73-45. Kirtland AFB: Air Force Weapons Laboratory, 3/73. (AD 908 615L)	MG, MC
Butala, E.F. and Deboy, P.E. *MIXED COMPANY, Engineering Test Report on Blast and Shock Effects of Equipment Installed in a S-2-80 Shelter.* Ft. Meade, MD: National Security Agency, 5/73. (AD 914 494L)	MC
Chapyak, E.J. and Cooper, H.F., Jr. *MIDDLE NORTH Series, MIXED COMPANY Event, Fluid Slosh Experiments,* POR-6745, WT-6745. Santa Monica, CA: Research and Development Associates, 7/73. (AD 913 530L)	MC-III
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*MO = Mine Ore MR = Mineral Rock
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